FINAL PROJECT

MADE A THERMOSTAT WITH A 4 AXIS CNC MACHINING PROCESS AND TOOLING DESIGN

A Graduation Project Report submitted by

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VALIDATION SHEET

This final project has been corrected and legalized by supervisor, knowing by Head of Mechanical Engineering Department, Wuxi of Technology and Secretary of International Program Automotive Engineering, Universitas Muhammadiyah Surakarta :

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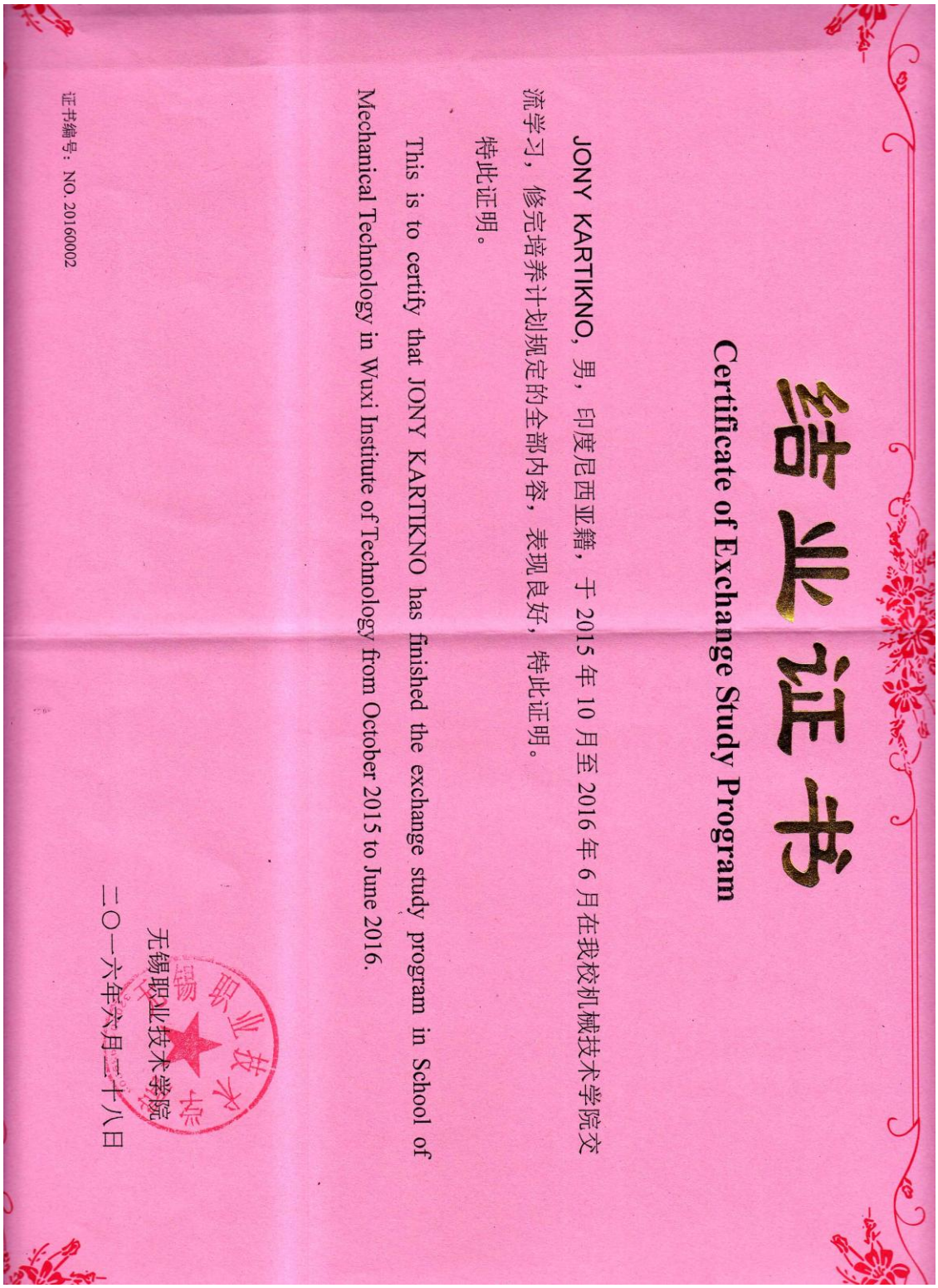
CERTIFICATE OF EXCHANGE STUDY PROGRAM



结业证书

Certificate of Exchange Study Program

JONY KARTIKNO，男，印度尼西亚籍，于 2015 年 10 月至 2016 年 6 月在我校机械技术学院交流学习，修完培养计划规定的全部内容，表现良好，特此证明。

This is to certify that JONY KARTIKNO has finished the exchange study program in School of Mechanical Technology in Wuxi Institute of Technology from October 2015 to June 2016.

无锡职业技术学院

二〇一六年六月二十八日

证书编号：NO. 20160002

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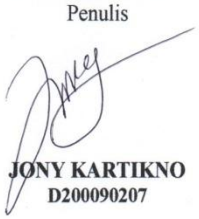

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MADE A THERMOSTAT WITH A 4 AXIS CNC MACHINING PROCESS AND TOOLING DESIGN

ABSTRACT

Also known as the thermostat thermostat, coolant flow path control valve. As a thermostat device comprising temperature sensitive components generally, by expansion or shrink to open, turn off the flow of air, gas or liquid. Its role is automatically adjusted according to the level of the engine cooling water temperature of water entering the radiator, change the water cycle range for adjusting the cooling capacity of the cooling system to ensure the engine is operating at a suitable temperature range. Thermostat body itself cast aluminum alloy, five-sided machining body, processing contents, excellent air tightness requirements of the finished product, the relative processing requirements are relatively high. Processing thermostat body's need to use modern CNC machine tools, CNC machine tools development trend of modern high-speed, high-precision, high reliability, multi-functional, complex, intelligent and open architecture. The main developments in the research and development of software and hardware with intelligent full-featured universal open architecture NC device. CNC machining technology is the basis for automation, CNC machine tools is the core technology, which is related to the level of national strategic position and reflects the level of comprehensive national strength. It is with the development of information technology, microelectronics technology, automation technology and detection techniques and development of. CNC machining center with a magazine and automatic tool change, the workpiece can be CNC machine tools, a variety of processing operations within a certain range.

Key words : Thermostat ; Computer numerical control machine tools ; Conventional machining CNC machine

ABSTRAKS

Juga dikenal sebagai termostat adalah aliran pendingin katup kontrol jalan. Sebagai perangkat termostat yang terdiri komponen sensitif suhu umumnya, dengan ekspansi atau menyusut untuk membuka, mematikan aliran udara, gas atau cair. perannya secara otomatis disesuaikan dengan tingkat mesin pendingin suhu air dari air masuk radiator, mengubah rentang siklus air untuk menyesuaikan kapasitas pendinginan sistem pendingin untuk memastikan mesin beroperasi pada kisaran suhu yang sesuai. Thermostat tubuh sendiri cast aluminium alloy, lima-sisi tubuh mesin, pengolahan isi, persyaratan sesak udara yang sangat baik dari produk jadi, persyaratan pengolahan relatif relatif tinggi. Pengolahan kebutuhan termostat tubuh untuk menggunakan peralatan mesin CNC modern, peralatan mesin CNC pengembangan tren modern berkecepatan tinggi, presisi tinggi, keandalan yang tinggi, multi-fungsional, kompleks, cerdas dan terbuka arsitektur. Perkembangan utama dalam penelitian dan pengembangan perangkat lunak dan perangkat keras dengan cerdas fitur lengkap yang universal arsitektur terbuka perangkat NC. teknologi mesin CNC adalah dasar untuk otomatisasi, peralatan mesin CNC adalah teknologi inti, yang terkait dengan tingkat posisi strategis nasional dan mencerminkan tingkat kekuatan nasional yang komprehensif. Hal ini dengan perkembangan teknologi informasi, teknologi mikroelektronika, teknologi otomatisasi dan teknik deteksi dan pengembangan. pusat mesin CNC dengan majalah dan perubahan alat otomatis, benda kerja dapat CNC peralatan mesin, berbagai operasi pengolahan dalam kisaran tertentu.

Kata kunci: Thermostat; Komputer kontrol numerik alat mesin; mesin konvensional mesin CNC

1. BACKGROUND

A thermostat is a component which senses the temperature of a system so that the system's temperature is maintained near a desired*setpoint*. The thermostat does this by switching heating or cooling devices on or off, or regulating the flow of a heat transfer fluid as needed, to maintain the correct

temperature. Thermostats are used in any device or system that heats or cools to a setpoint temperature, examples include building heating, central heating, air conditioner, HVAC system, as well as kitchen equipment includingovensandrefrigeratorsand medical and scientific incubators.

A thermostat is often the main control unit for a heating or cooling system, through setting the target temperature. Thermostats can be constructed in many ways and may use a variety of sensors to measure the temperature, commonly a thermistor or bimetallic strip. The output of the sensor then controls the heating or cooling apparatus. A thermostat is most often an instance of a "bang-bang controller" as the heating or cooling equipment interface is not typically controlled in a proportional manner to the difference between actual temperature and the temperature setpoint. Instead, the heating or cooling equipment runs at full capacity until the set temperature is reached, then shuts off. Increasing the difference between the thermostat setting and the desired temperature therefore does not shorten the time to achieve the desired temperature. A thermostat may have a maximum switching frequency, or switch heating and cooling equipment on and off at temperatures either side of the setpoint. This reduces the risk of equipment damage from frequent switching.

When the diesel engine gas temperature up to about 1800 ℃, to make direct contact with the gas cylinder head, cylinder liner serious heat, pistons, valves, fuel injectors and other components. Severe heat can cause: ① mechanical properties of materials decreased, resulting in greater thermal stress and deformation, leading to the above components fatigue cracks or plastic deformation; ② undermine the normal gap between the moving parts, causing excessive wear, or even bite each other dead or accident damage; ③ parts around the combustion chamber temperature is too high, the intake air temperature increases, the density decreases, thereby reducing the amount of intake air; pressurized air temperature will rise and affect the amount of intake air; ④ lubricants the temperature is gradually increased, viscosity decreases, the friction surface is not conducive to the formation of the film,

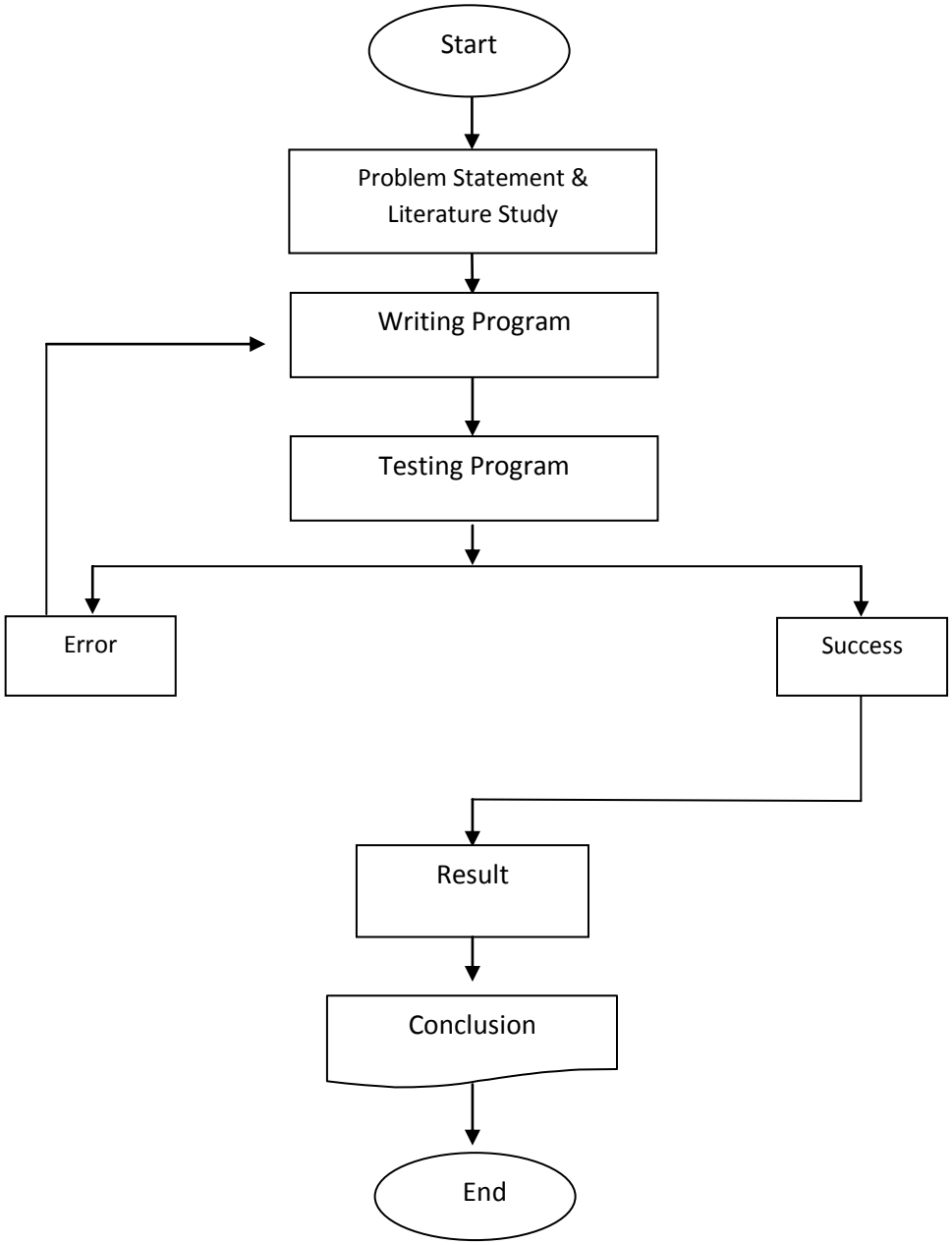
and even loss of lubrication. In summary, in order to ensure reliable operation of the diesel engine must be heated diesel engine parts, oil and pressurized air and the like for cooling.

However, from the point of view of energy use, cooling diesel engine is an energy loss will result in excessive cooling of fuel ignition delay period is extended, resulting in incomplete combustion and detonation, plus increased heat loss; parts inside and outside temperature difference is too large, so that the thermal stress the strength of the material over itself and cracks, oil viscosity becomes large increase friction power consumption; at higher fuel sulfur content of heavy oil, will produce low temperature corrosion, cylinder liner so severe corrosion. Therefore thermostat process design and fixture design and processing has become the core of the problem.

2. RESEARCH METHODOLOGY

The workpiece is a diesel engine thermostat body, the shape of complex, thin wall and uneven, the internal cavity was shaped, multi-site processing, difficult process, both the high accuracy required holes and flat, there are many low accuracy requirements fastening holes.

The flow chart of research can be explained below:



Each chart can be explained below:

1. Problem statement and literature

   Problem statement is the first step to determine the urgency of the research. Then review literature is conducted to strengthen and support theory and practical of the research.

2. Writing Program

The program of MasterCAM should be compiled but before we compile the program we ought to read and understand what does CNC itself.

3. Testing program

After assembling the program, its ready to run, but we should make simulation, in that case we use the problem

4. Result

The result from program is making thermostat.

Figure 1 Thermostat Workshop

5. Conclusion

If we can make the goods properly and be successful then it will be easy to produce with scale lots. Moreover aspect will minimize human error and maximize time.

3. RESULT ANALYZE

1. Determine The Step Size and The Machining Allowance

Determining allowance for machining parts up and down the steps of the process are closely linked, including the processing speed of the process and the next step size machining precision.

Table.1 Margin calculation and dimensional tolerances

Project name / Process	Step Size	Deviation	margin	Margin change
Finishing	ϕ32	- 0.04 - 0.25	0.3	+ 0.2 - 0.26
	ϕ24	- 0.04 - 0.25	0.25	+ 0.21 - 0.21
	ϕ18	- 0.032 - 0.212	0.25	+ 0.172 - 0.218
	ϕ22	- 0.04 - 0.25	0.25	+ 0.21 - 0.21
Semi-finishing	ϕ32.3	- 0.05 - 0.30	0.3	+ 0.25 - 0.25
	ϕ24.25	- 0.04 - 0.25	0.25	+ 0.21 - 0.21
	ϕ18.25	- 0.04 - 0.25	0.25	+ 0.21 - 0.21
	ϕ22.25	- 0.04 - 0.25	0.25	+ 0.21 - 0.21
Roughing	ϕ32.6	- 0.05 - 0.30	1.8	+ 0.25 - 0.25
	ϕ24.5	- 0.04 - 0.25	1.6	+ 0.21 - 0.21

	ϕ18.5	- 0.04 - 0.25	1.6	+ 0.21 - 0.21
	ϕ22.5	- 0.04 - 0.25	1.6	+ 0.21 - 0.21

2. Determine Cutting Parameters and Process Time Quota

Cutting the amount calculated in step 10 as an example of an external circular machining. First, the mechanical properties of the tool to YG8 as a reference, the relative density of 14.4 ~ 14.8 (g / cm3), the thermal conductivity of 75.4W / mc, hardness 74HRC, use a larger tool rake angle Vo = 20o, posterior horn λS = 0o , A = (dw-d) / 2 = (45-32.6) /2=6.2mm, if divided into five passes then A '= 1.24mm, ap = (2/3 ~ 3/4) A' = 0.8mm, depending on the surface roughness look-up table f = 0.4mm / r,

Cutting speed Vo = Cr * Kv / 60 (1-m) (2)

Table.2 Cutting Parameters

No	Process	Diameter	Spindle speed	Feed rate
			r/min	mm/min
1	Drill 3/4 threaded holes	Φ24	S500	F150
2	Roughing large flat	Φ100	S1500	F800
3	Finishing large flat	Φ100	S1500	F600
4	Milling facets	Φ20	S1800	F800
5	Roughing large flat Φ71 hole	Φ20	S4500	F1200
6	Roughing large flat	Φ20	S4500	F2000

	Φ61 hole			
7	Finishing large flat Φ61 hole	Φ20	S4500	F2000
8	Roughing large flat	Φ100	S1500	F800
9	Finishing large flat	Φ100	S1500	F600
10	Drill the threaded holesM12 * 1.5	Φ10	S3000	F150
11	M8 threaded hole chamfering	Φ14	S4000	F600
12	1/8 threaded hole chamfering	Φ14	S4500	F800
13	3/4 threaded hole chamfering	Φ14	S4000	F800
14	Milling 3/8 threaded hole	Φ14	S4000	F500
15	3/8 threaded hole chamfering	Φ14	S4000	F500
16	M12 * 1.5 screw hole chamfering	Φ14	S3500	F500
17	Φ9 center point hole	Φ14	S4500	F500
18	Φ55 hole chamfering	Φ14	S4500	F600

4. CONCLUSION

1. Conclusions

Based on the result of experiment that we have already done above, we can conclude that the result of the applications which have been ran by the code is same with the result of analytic CNC Machine.

Consequently this application is really precise enough to be applied in the school for studying CNC, not only for studying purposes this application could also be developed seriously in order to be applied in industry.

2. Suggestions

The suggestions below were taken in order to more accurately the result of research and as consideration for the next study. In order to getting close result with real condition, the author gives some suggestion below:

1. In the finding and Inputting the initial data should be careful based on condition and experience. Condition is mean the ability of common machine are different. Others, the environment factor are giving big effect on the production parameters. And experience means every special case need specials treatment as well.
2. Fabrication of cutting tools are so many around in the worlds. So, need more attention in choosing cutting tool material and type for rough-production. Even rough-machining is not finishing process but give big influence in finishing product.
3. Others consideration is workpiece material are very much around in the world. Before and during production may change the materials properties also treatment during the process will be effected to production parameters (like cooling system). so is need pay attention when making simulation.

4. Finally, the authors hope that this report is useful for everyone who read it and become recommendation and consideration for the next production.

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